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A New Species of *Quadrastichus* (Hymenoptera: Eulophidae): A Gall-inducing Pest on *Erythrina* (Fabaceae)

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Abstract.—*Quadrastichus erythrinae* Kim sp.n. is described from Singapore, Mauritius and Réunion. This species forms galls on the leaves, stems, petioles and young shoots of *Erythrina variegata* and *E. fusca* in Singapore, on the leaves of *E. indica* in Mauritius, and on *Erythrina* sp. in Réunion. It can cause extensive damage to the trees.

Key words.—Hymenoptera, Eulophidae, *Quadrastichus*, phytophagous, gall inducer, Singapore, Mauritius, *Erythrina*, Fabaceae

Species of Eulophidae are mainly parasitoids, but secondary phytophagy in the form of gall induction has arisen on many occasions (Bouček 1988; La Salle 1994; Headrick et al. 1995; Mendel et al. 2004; La Salle 2004). Gall-inducing Eulophidae generally belong to two groups: Ophelimini is an Australian lineage which consists mainly of gall inducers on eucalypts, but perhaps also on some other myrtaceous hosts (Bouček 1988; La Salle 2004); and Tetrastichinae includes several instances of gall induction, but it is questionable that these represent a single evolutionary event (La Salle 2004). Genera of Tetrastichinae where gall induction is known to occur include *Quadrastichodella*, *Oncastichus*, *Epichrysocharis*, *Aprostocetus*, *Paragaleopsomyia*, *Ceratoneura*, *'Exurus'*, and *Leptocybe* (La Salle 2004; Mendel et al. 2004).

Several species of tetrastichine gall inducers have become invasive pests, particularly in the last decade, these include: *Quadrastichodella nova* Girault (Flock 1957, as *Flockiella eucalypti*; Timberlake 1957, as *Flockiella eucalypti*; Bouček 1988); *Oncastichus goughi* Headrick & LaSalle (Gough 1988; Redak and Bethke 1995; Headrick et al. 1995); *Epichrysocharis burwelli* Schauff (Schauff and Garrison 2000); and *Leptocybe invasa* Fisher & La Salle (Mendel et al. 2004). *Quadrastichus erythrinae* Kim sp.n. has recently achieved pest status in Singapore, Mauritius and Réunion. *Erythrina* trees have been grown in these areas for decades, and this species has never been recorded from them. Although its exact origin remains unknown, it is likely to represent another example of an invasive pest species.

There are approximately 110 species of *Erythrina* around the world, mostly found in tropical regions (Mabberly 1987). Their beautiful red flowers have earned them the common name of coral trees, and made them a popular tree to be used in landscaping in many tropical regions.

Recently, a eulophid species was found from galls on *Erythrina* in Singapore and sent to one of us [JL]; at about the same time galls were found in Mauritius and Réunion, with wasps being sent to another of us [GD]. Comparison of the two samples showed that there was a single, widespread species involved. This wasp can

cause severe damage to *Erythrina* trees, and has become a nuisance in these countries.

Records of gall-inducing wasps on *Erythrina* are not extensive. Annecke & Moran (1982) reported on *Erythrina* galls in South Africa. Five species of chalcidoid wasps were reared from these galls, the most common being a Eulophidae sp. and a *Eurytoma* sp. (Eurytomidae). At that time, the *Eurytoma* was suspected as being the gall inducer. Recent examination of the material (by Dr. G.L. Prinsloo) has shown that there are two eulophid species present, but neither of them are the same as *Q. erythrinae*. Because this species was found on Réunion and Mauritius, one of us [GD] compared this species with all species described by Risbec from Madagascar; however, it did not agree with any previously named species.

Quadrastichus erythrinae Kim represents the first record of a gall inducer in the genus *Quadrastichus*. Species of *Quadrastichus* have a variety of biologies: many are parasitoids of gall-inducing hosts, such as Cecidomyiidae (Diptera) and Cynipidae (Hymenoptera); others are parasitoids of Buprestidae and Curculionidae (Coleoptera), or Agromyzidae and Tephritidae (Diptera); *Q. sajoi* (Szelényi) larvae are predators of eriophyid mites within galls (Graham 1991, La Salle 1994, Hansson and La Salle 1996).

Terminology used in this paper is taken from Gibson (1997) and Graham (1987); OOL, ocell–ocular distance; POL, postocellar distance; MPS, multiporous plate sensilla.

Acronyms used in the text are as follows. ANIC, Australian National Insect Collection, CSIRO Entomology, Canberra, Australia; BMNH, The Natural History Museum, London, UK; CIRAD, Centre de Coopération Internationale en Recherche Agronomique pour le Développement; CNC, Canadian National Insect Collection, Ottawa, Ontario, Canada; MZB, Museum Zoologicum Bogoriense, Bogor, Indonesia; PPRI, Biosystematics Division, Plant Protection Research Institute, Pretoria, South Africa; QMB, Queensland Museum, Brisbane, Australia; USNM, United States National Museum of Natural History, Washington, D.C., USA.

SYSTEMATICS

Quadrastichus erythrinae Kim, sp.n.

(Figs 1–10)

Types. Holotype ♀: SINGAPORE, 02.vi.2003, He Liansheng, reared from galls on *Erythrina fusca* (ANIC).

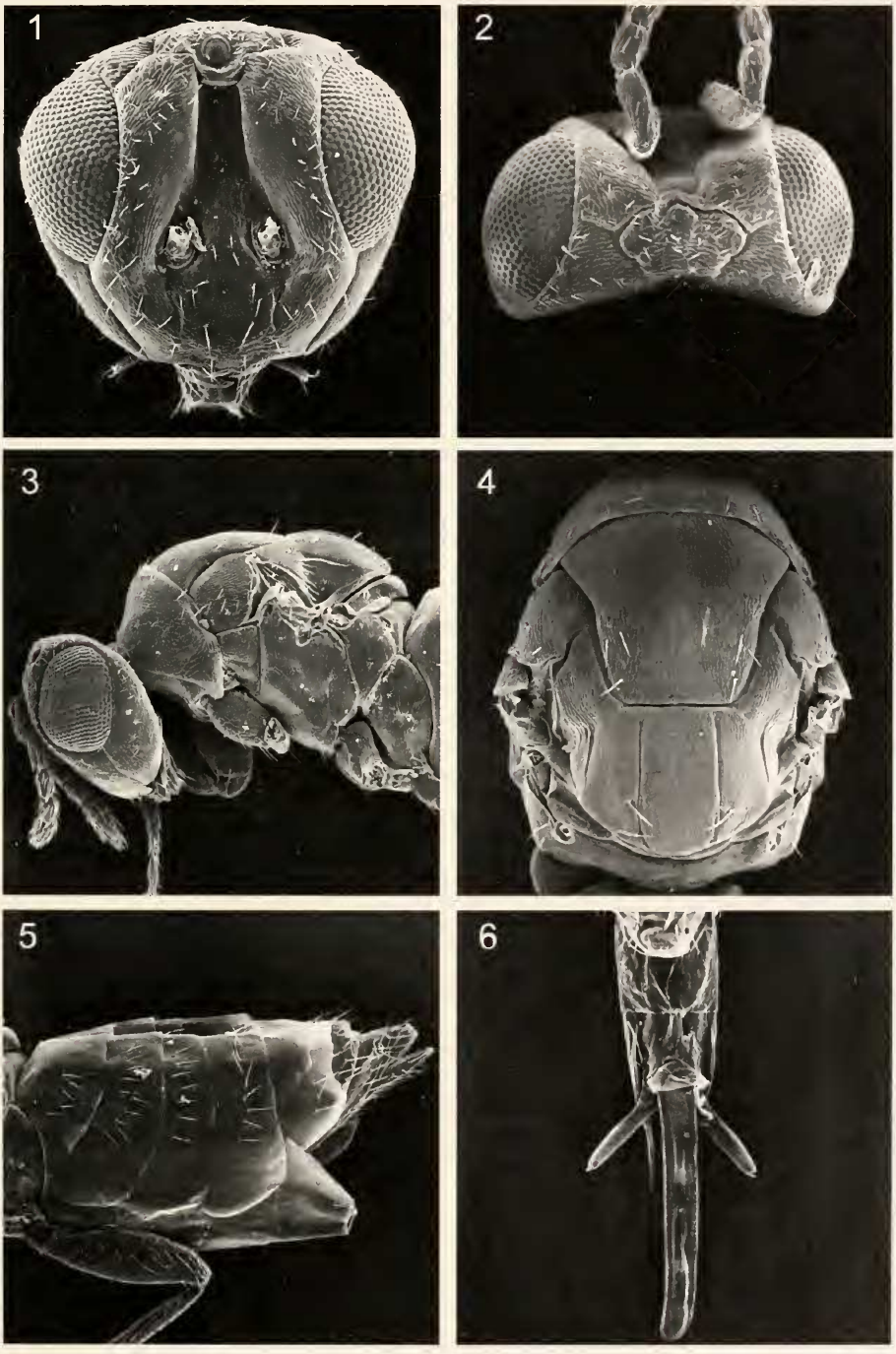
Paratypes: 63♀, 118♂, Same data as Holotype (28♀, 83♂ ANIC; 5♀, 5♂ each: BMNH, CIRAD, CNC, MZB, PPRI, QMB, USNM).

Non-type material: MAURITIUS: Bras d'Eau, 04.iv.2003, D. Ramkhelawon, vii.03, ex. *Erythrina indica* leaves (12♀, 14♂, ANIC); Quatre Bornes, 17.vii.2003, (S. Permalloo), ex. leaf galls on *Erythrina indica* (3♀, 5♂, ANIC). LA RÉUNION: Saint-Pierre, Bassin Plat, 06.xii.2000, G. Delvare & A. Franck, ex. galls on *Erythina* sp. (33♀, 38♂ CIRAD); Saint-Benoît, 24.ii.2003, S. Quilici, ex. galls on *Erythina* sp., Ref. N° RQ 4611 & Cirad 18009 (21♀, 11♂ CIRAD).

Description

Female Length 1.45–1.6 mm. Dark brown with yellow markings. Head yellow, except gena posteriorly brown. Antenna pale brown except scape posteriorly pale. Pronotum dark brown. The mid lobe of mesoscutum with a "V" shaped or inverted triangular dark brown area from anterior margin, the remainder yellow. Scapula yellow. Scutellum, axilla and dorsellum brown to light brown. Propodeum dark brown. Gaster brown. Fore and hind coxae brown. Mid coxa almost pale. Femora mostly brown to light brown. Specimens from Mauritius are generally darker than those from Singapore.

Head (Figs 1–2). Ocellar triangle surrounded by groove; transverse groove ex-



Figs. 1–6. *Quadrastichus erythrinae* sp. n.—1. Head, frontal view; 2. Head, dorsal view; 3. Head and thorax, lateral view; 4. Mesosoma, dorsal view; 5. Gaster, lateral view; 6. ♂ Genitalia, dorsal view.

tending from lateral ocellus to eye. POL 1.6–2.0 times longer than OOL. Frons with broad median area, but without median carina. Toruli situated at level of lower eye margin. Shallow groove present beneath torulus, extending slightly over half the distance from torulus to clypeal margin. Gena slightly swollen and malar sulcus only slightly curved, without triangular fovea below eyes. Clypeal margin bidentate.

Antenna (Fig. 7) with one large anellus. All funicular segments 1.3–1.6 times longer than wide and each segment approximately equal in length and width to the others. However, under the microscope with slide-mounted antenna, each successive segment appears slightly wider than previous one. Sensilla (MPS) slightly shorter than length of funicular segment, each sensilla reaching to the next funicular segment; 1–2 sensillae visible on each segment in lateral view. Scape not extending above the vertex.

Mesosoma (Figs 3–4). Median line on the mid lobe of mesoscutum very weak to absent but usually at least indicated in certain angles and light; if indicated, it can be seen superficially only in posterior half. Mid lobe of mesoscutum with 3 to 5 short adnotaular setae. Scutellum with distinct submedian lines and sublateral lines; 2 pairs of setae on scutellum (occasionally with an additional seta), anterior seta situated well behind midlength of scutellum. Precoxal suture distinct and extending about 0.7 length of mesopleuron. Propodeal spiracle relatively large, whole rim exposed. Propodeum without distinct median carina or paraspiracular carina. Propodeal callus with 2 setae.

Wing (Figs 9–10). Submarginal vein with 1 seta, situated slightly basal to the middle. Costal cell without setae. Postmarginal vein almost rudimentary; less than 0.3 length of stigmal vein. Costal cell: marginal vein: stigmal vein: postmarginal vein = 3.9–4.1: 2.8–3.1: 1.0: 0.1–0.3. Cubital line of setae not extending all the way to basal vein, leaving the speculum partially open behind; the speculum small.

Gaster (Fig. 5). Slightly longer than the head plus mesosoma. Hypopygium extending 0.8–0.9 the length of gaster and reaching up to the posterior margin of G6. Ovipositor sheath not protruding, short in dorsal view. Cercus with 3 setae, the longest one slightly curved and about 1.3 as long as the others, which are subequal in length.

Male. Length 1.0–1.15 mm. Pale coloration white to pale yellow as opposed to yellow in female. Head and antenna pale. Pronotum dark brown (but in lateral view, only upper half dark brown; lower half yellow to white). Scutellum and dorsellum pale brown. Axilla pale. Propodeum dark brown. Gaster in anterior half pale; remainder dark brown. Legs all pale.

Antenna (Fig. 8) with 4 funicular segments; without the whorl of setae; F1 distinctly shorter than the other segments and slightly transverse; about 1.4 wider than long. Ventral plaque extending 0.4–0.5 length of scape and placed in apical half.

Gaster shorter than female. Genitalia (Fig. 6) elongate, with digitus about 0.4 length of the long, exserted aedagus. [Dorsally exposed parts of the genitalia were measured.]

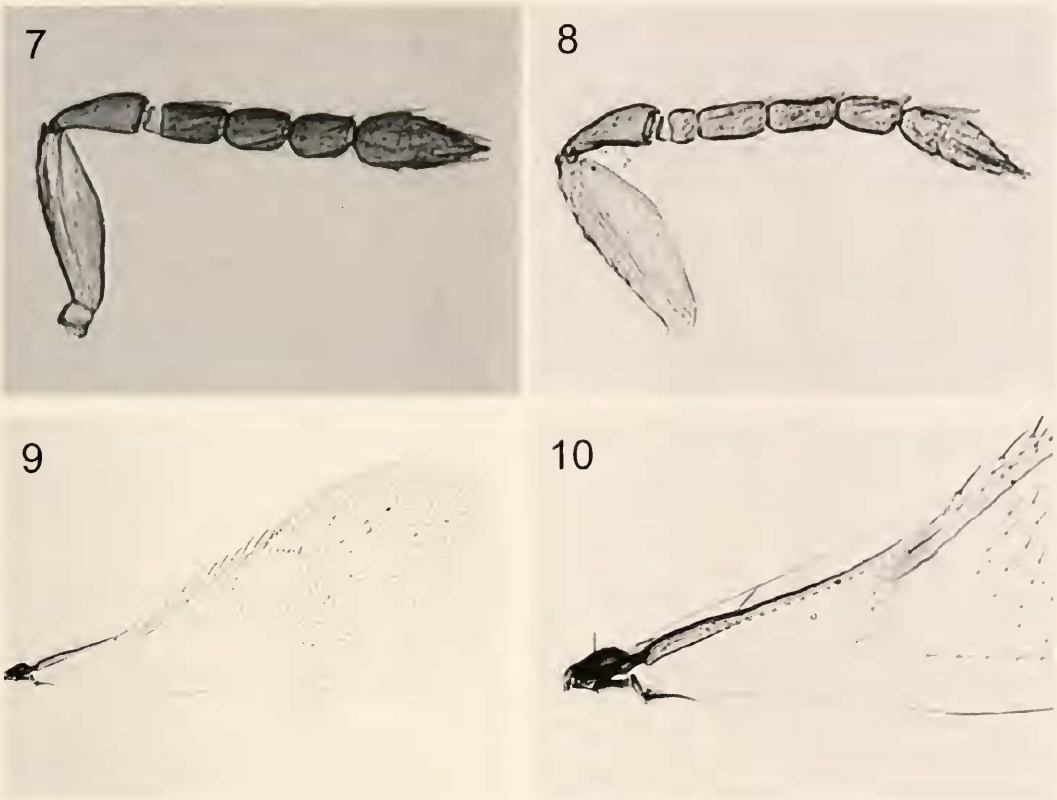
Etymology. The specific name *erythrinae* comes from the genus name of the host plant.

Biology. Reared from galls on *Erythrina variegata* L., *E. fusca* Lour. (=*E. glauca* Willd.) and *E. indica* L. (Figs 11–12). Inside the leaf galls there is usually only one wasp per cell, while in the swollen tissues of shoots, twigs and petioles more than five individuals were observed.

Distribution. Singapore, Mauritius, Réunion. It is not known if this wasp is native to one of these regions or not.

Discussion

This species fits the definition of *Quadrastichus* offered by Graham (1991): SMV



Figs. 7–10. *Quadrastichus erythrinae* sp. n.—7. Antenna, ♀; 8. Antenna, ♂; 9. Forewing; 10. Submarginal vein.

Figs. 11–12. Galls on stems, petioles, and young shoots of *Erythrina* induced by *Quadrastichus erythrinae*.

with 1 dorsal seta, antenna with all funicular segments longer than wide and with 1–3 anelli in female and gaster longer than the head plus mesosoma. However, the species is distinct from all other *Quadrastichus* on the basis of the long hypopygium.

The only key to species of *Quadrastichus* of any region is Graham (1991) for European species. In this key, this species would run to the *anysis*-group of *Q. anysis* (Walker), *Q. citrinus* (Thomson) and *Q. xanthosoma* (Graham) as follows: body black and yellow as opposed to metallic and without yellow markings; frons with median area but without median carina; gena slightly swollen, malar sulcus only slightly curved, malar sulcus without a large subtriangular fovea just beneath eye.

However, *Quadrastichus erythrinae* differs from the *anysis*-group because: clypeal margin bidentate, scape not exeeding above the vertex, apex of hypopygium extending distinctly beyond middle of gaster. Males of the *anysis*-group have whorls of long setae on the funicular segments (Graham, 1991; Reina & La Salle, 2004), however these are absent in *Q. erythrinae*. Additionally, the *anysis*-group appears to be restricted to leafminer hosts.

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